FORESTRY RESEARCH

WHAT'S NEW IN THE WEST APRIL 1976

U.S. Department of Agriculture Forest Service

a note to you

Forestry Research: What's New in the West, is a report on the work of the USDA Forest Service's four Forest and Range Experiment Stations in the West. These research centers, and the states included in their areas of study are: Rocky Mountain (North Dakota, South Dakota, Nebraska, Kansas, Colorado, Arizona, New Mexico, and part of Wyoming, Oklahoma, and Texas); Intermountain (Montana, Idaho, Utah, Nevada, and part of Wyoming); Pacific Northwest (Alaska, Oregon, and Washington); and Pacific Southwest (California, Hawaii, Guam, and American Samoa).

on the cover

Access to research sites in Alaska may be by helicopter, by boat, or by "the pack horse of Alaska," the float plane, shown here on the shore of an Alaskan lake.

our addresses

Single copies of most of the publications mentioned in this issue are available free of charge. When writing to research Stations, please include your complete mailing address (with ZIP) and request publications by author, title, and number (if one is given).

For INT publications write:

Intermountain Forest and Range
Experiment Station
507 25th Street
Ogden, Utah 84401

For PSW publications write:

Pacific Southwest Forest and Range
Experiment Station
Post Office Box 245
Berkeley, California 94701

For PNW publications write:

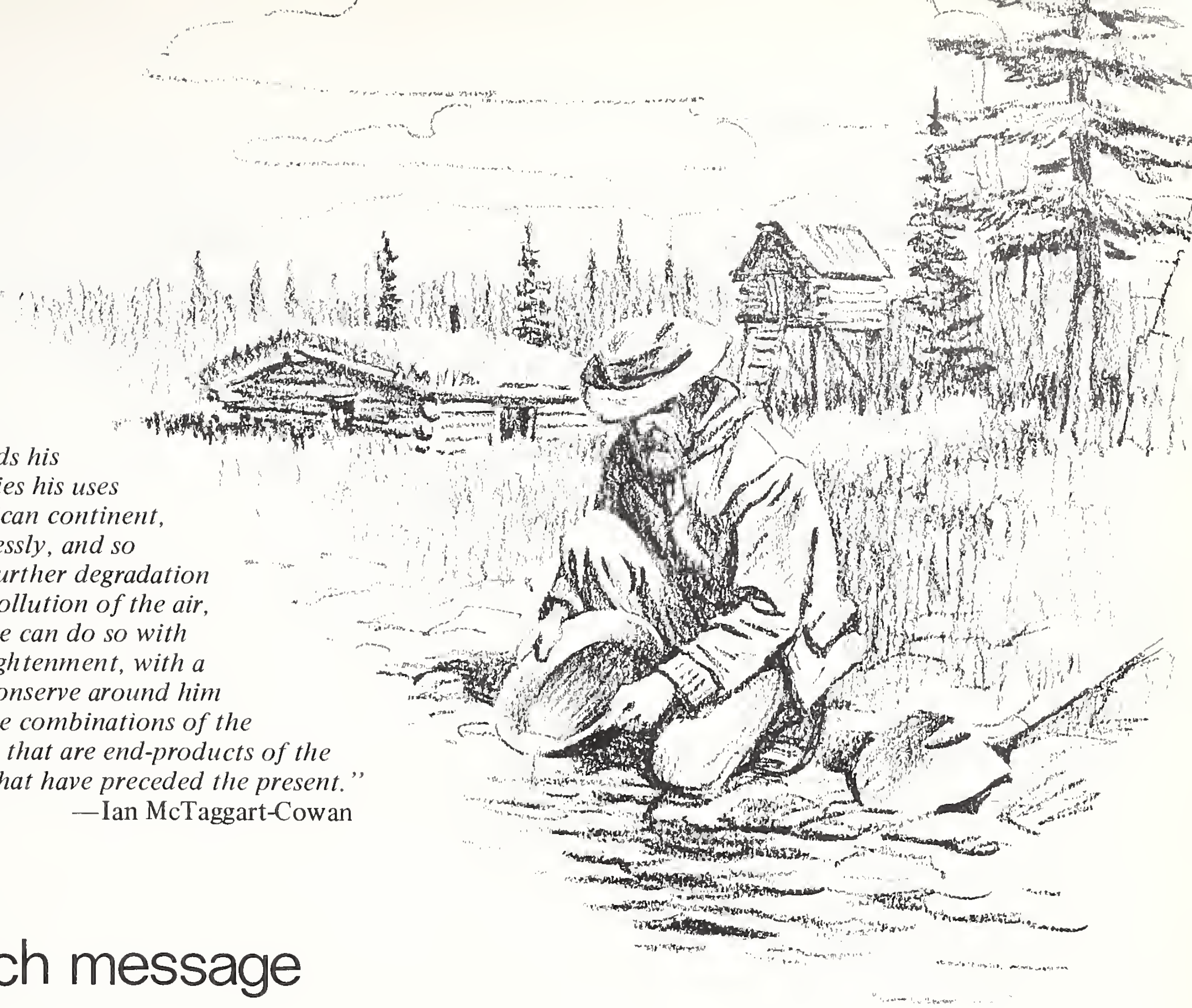
Pacific Northwest Forest and Range
Experiment Station
Post Office Box 3141
Portland, Oregon 97208

For RM publications write:

Rocky Mountain Forest and Range
Experiment Station
240 West Prospect Street
Fort Collins, Colorado 80521

If you are planning to move, please notify us as much in advance as possible. Send your old address, your new address, and the address label from the back cover to *Forestry Research: What's New in the West,* 240 West Prospect Street, Fort Collins, Colorado 80521.

When reprinting articles, please credit USDA Forest Service. Mention of commercial products in this issue is for information only—no endorsement by the U.S. Department of Agriculture is implied.



". . . as man expands his occupancy and varies his uses of the north American continent, he can do so heedlessly, and so contribute to the further degradation of landscape, the pollution of the air, and the water, or he can do so with sensitivity and enlightenment, with a determination to conserve around him the greatest possible combinations of the biological treasures that are end-products of the eons of evolution that have preceded the present."
—Ian McTaggart-Cowan

a research message

Alaska is changing! Within the past few years remote, untouched Alaska has experienced a surge of growth. The development of the north slope oil field, the influx of people from other states, and the allocation of lands under the Alaska Native Claims Settlement Act have all contributed to the changing patterns.

One of the most significant changes is the increasing demands for Alaska's natural resources. Timber from southeast Alaska and a growing interest in the timber potential of the interior is part of this picture. In addition, people are flocking to Alaska in unprecedented numbers.

Fortunately these developments are occurring at a time of heightened environmental awareness. Now, as never before, people are expressing a deep concern about environmental factors contributing to a quality life. This awareness will have a lasting effect on the management and utilization of Alaska's resources.

Cooperation is the key to environmentally sound and effective resource management on federal, state, private, and native corporation lands. The Forest Service, through the Institute of Northern Forestry in Fairbanks and the Forestry Sciences Laboratory in Juneau, is working with other federal agencies, state governments, and landowners to ensure that resource management in the Land of the Midnight Sun is based on the best and most current research information available.

◀ Route of the National Forest work boat *Tongass Ranger* is the southeast inside passage.

Alaska's coastal and interior forests

Timber covers much of Alaska, from the beautiful offshore islands in the southeast portion of the State through the dense coastal area to the forests of the interior.

Wood from these forests was used by early man for tools, warmth, and dwelling places. It wasn't until the middle part of the present century that industrial consumption began to make significant use of the timber resource.

Early-day forest management has been described as custodial, with an emphasis on forest protection. Little was known about the factors involved in the regeneration and growth of Alaska's forest trees. In 1948, a Forest Research Center was established by the Forest Service at Juneau. Twenty years later the Juneau facility, renamed the Forestry Sciences Laboratory, and the Institute of Northern Forestry at Fairbanks, became administrative units of the Pacific Northwest Forest and Range Experiment Station.

In the past 27 years, researchers have made significant progress in understanding the complexities of the Alaskan forests. The research picture is by no means complete and perhaps never will be. However, the gaps in a basic understanding of the ecosystem are gradually being filled in.

The key to understanding the forests of Alaska lies in the fact that the coastal forests and the interior forests are two separate worlds. The 13 million forested acres of coastal Alaska are characterized by magnificent stands of Sitka spruce, western and mountain hemlock, western redcedar and Alaska cedar. These forests are extensions of the coastal rain forests of Oregon, Washington, and British Columbia. This is in contrast to the 106 million acres of mixed white and black spruce, paper birch, aspen and balsam poplar found in the interior.

The coastal forests hold about 86 percent of the total commercial sawtimber volume in Alaska, averaging more than 30,000 board feet per acre and ranging anywhere from 8,000 to more than 100,000 board feet. Timber volumes in the interior are lower, with an estimated 22½ billion board feet of commercial sawtimber averaging slightly over 3,000 board feet per acre.

▼ Load of logs at Corner Bay in southeast Alaska.

Part of the reason for this difference lies in the average age of timber stands in the interior and along the coast. The coastal forests are composed of a large volume of old-growth, while the interior forests are much younger, due to frequent summer wildfire. The major difference in sawtimber volume is related to the productivity of the land and this is based on differences in climate and soil.

In general, reforestation in the coastal forests of southeastern Alaska occurs naturally. The process of stand regeneration is well understood. Conifer seedlings that escape logging and seed from nearby trees combine to produce the new stand. The removal of shade from the logged overstory increases ground temperatures, light, and biological soil activity. Researchers have found that the open conditions created by clearcutting favor the growth of Sitka spruce. For this reason, the percentage of spruce seedlings is higher in clearcut areas than in old-growth forests.

Initial growth is relatively slow and it may take up to 10 years for a clearcut to green up. In one experimental area, dominant hemlock averaged 24 feet in height and dominant spruce 15 feet in height within 15 years following logging. Crown closure begins to occur sometime between 15 and 20 years. This is about the time the spruce and hemlock stands begin to reach their maximum growth rate. The volume of wood produced by a normally-stocked stand 30 years old is expected to average 3,800 cubic feet of wood per acre. The same stand at age 50 has almost doubled its wood volume to 7,275 cubic feet.

Silvicultural programs

Most researchers agree that for hemlock-spruce stands, clearcutting is the preferred harvest system both from the point of view of silviculture and economic necessity in the high-cost Alaskan economy. Al Harris of the Forestry Sciences Laboratory in Juneau feels that clearcutting will remain the most important silvicultural system in the future but that shelterwood and selection systems will increase in importance in managed stands.

Regeneration is only one of several silvicultural programs currently underway in southeast Alaska. Other studies focus on stand density, windthrow, and the relationship of logging systems to anadromous fish production and rearing.

At present, there is a developing timber industry in the interior. Several small mills are now in operation, producing lumber for home use and cants for export to overseas markets. This infant industry may be the harbinger of things to come.

It is difficult to separate silviculture from fire when discussing interior Alaska (see "Studying Fire in the Interior," p. 5). Fire is the single most important factor in maintaining the vegetational mosaic found throughout much of the interior. The occurrence of wildfire and the immense areas burned contribute to both the frequency and geographical distribution of many tree species.

Spruce and hardwoods

White spruce is presently the most important commercial species, although the hardwoods show a strong potential for future development. John Zasada, of the Institute of Northern Forestry, has found that the soil requirements for white spruce regeneration include a mineral soil seedbed. The amount of regeneration is greater when scarification is used for site preparation. Zasada has found that clearcutting and shelterwood are equally effective in producing regeneration. However, clearcutting allows more light and heat to reach the soil and may produce more rapid initial seedling growth and establishment. Zasada feels that his research has demonstrated that, at present harvest levels, natural regeneration is generally sufficient to reforest logged stands.

Hardwood research is in its initial stages in interior Alaska. Research plots have been established to investigate the regeneration of birch, poplar, and aspen. Zasada feels that the life cycle of these species in the interior will be similar to that found throughout the rest of their Northern Hemisphere range. Research concerning the hardwoods will become increasingly important as these species enter the developing commercial markets for interior timber.

Alaska is entering a period of growth and expansion. The anticipated division of lands between native corporations and local, State, and Federal jurisdictions points to the need for expanded research programs. The research already underway is just a small part of that necessary to ensure the wise use of Alaska's forest and related resources.

—By Thomas M. Baugh, Pacific Northwest Station

Studying fire in the interior

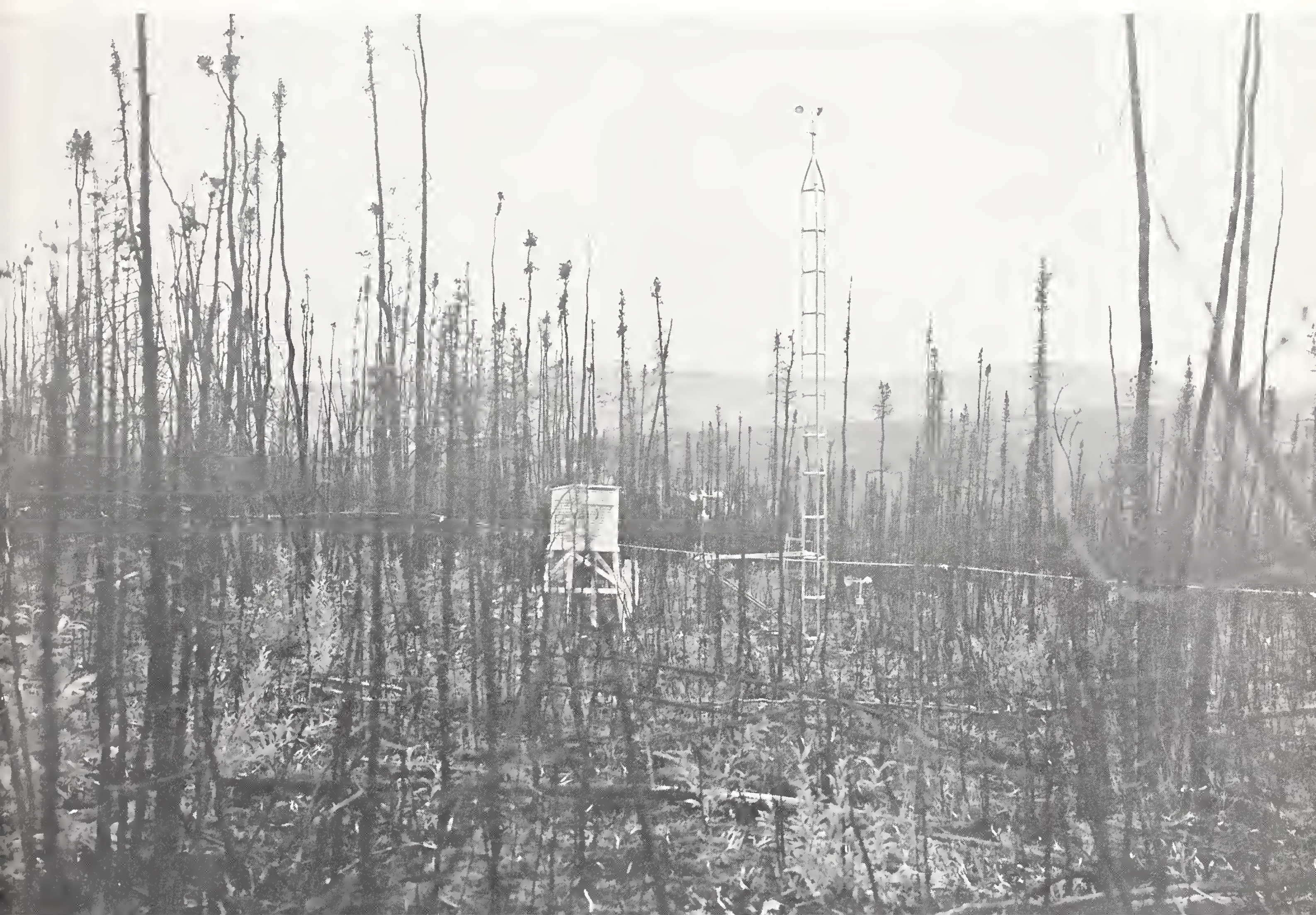
A June storm rolls in over the mountains, dropping lightning bolts into the dry forest. A tiny stream of smoke curls up and in minutes several trees are ablaze. Soon, a whole hillside is covered with smoke.

With luck, the fire has been spotted within a few minutes of its start, and reported. A Bureau of Land Management crew, dispatched from the nearest smokejumper center, is quickly on the way.

It is a scene repeated many times in the Western United States during the summer months. But this time the scene is interior Alaska.

Alaska's great interior is a very special environment. A land of great mountain ranges, snow, ice, and glaciers, it is also a land of great river systems—the Yukon, Copper, Susitna, Kobuk, and Kuskokwim. There are also lowlands, rolling hills, and wide expanses of forest.

▼ Fire is an ever-present part of interior Alaska's ecosystem. Here, snags of burned black spruce conceal new vegetation.



Fire is an ever-present part of the environment of the interior. It has been a part of the ecosystem for the past several thousand years. As a result, the vegetation is a subtle mosaic that includes mixtures of birch, poplar, and cottonwood trees, black and white spruce, and recently burned areas that are just beginning to recover from fire.

The Bureau of Land Management manages most of the interior stretching from the Alaska Range north to Prudhoe Bay, an area of about 172 million acres. The BLM's Alaska Fire Control Service was established in 1946, with the charter to extinguish all fires. More recently, a new management policy for BLM in Alaska requires initial attack on all fires. Then, if a particularly hot fire eludes control, a top-level management team evaluates the situation. Today, in some cases, a decision may be made to let the fire burn itself out naturally. Although this policy is still controversial in other parts of the United States, it makes sense in Alaska's interior, in stands of low-volume black spruce and in areas where fire is important in maintaining browse for some kinds of wildlife.

The BLM reports an average of more than 400 fires a year, with about 800,000 acres burned annually. Some years that total runs as high as 5 million acres. Although about two-thirds of the fires are man-caused, lightning fires do more extensive damage because they often start in inaccessible places.

A fire environment

In this environment, fire research is especially important. The Forest Service is currently reviewing its fire research program at the Institute of Northern Forestry at Fairbanks. The Institute is a field unit of the Pacific Northwest Forest and Range Experiment Station. Since 1971, the research has concentrated on fire effects, emphasizing the ecological role of fire in the environment, and learning more about how fire affects succession in various forest types. Resource managers from the BLM and other groups are using this information.

What scientists have learned about fire in the northern environment is impressive. Their reports detail the role of fire in creating a vegetation mosaic that is unique to the far north and beneficial to the wildlife and plant communities involved. In short, it is distinctly a "fire environment," in which the plants and animals that live there have adapted to the periodic burning of the forests.

There are several vegetation types in the interior. All are susceptible to fire, but each reacts somewhat differently. Biologist Joan Foote of the Institute of Northern Forestry has been conducting studies to learn more about those responses. She has been at the laboratory since 1964, and in 1971 began work on fire effects. A map in her office shows all the fires in northern Alaska in the past 10 years. Her goal is to study fires in order to pin down the successional patterns that have occurred in each of the various forest types.

Permafrost affected

So far, 130 burned stands have been studied. Most of the research plots are within 60 miles of Fairbanks (it makes travel easier). Plots have been set up at all of the areas that can be reached by road. Many plots, however, must be visited by helicopter, float plane, or boat.

Black spruce grows primarily on the poorer sites, in cooler places that may be boggy and are usually underlain by permafrost. It is the spindly black spruce forests for which the taiga is named. Taiga is a Russian word meaning "land of little sticks."

In the black spruce forest, six separate community types have been identified. In the white spruce community, four types have been identified.

In a typical black spruce type, the mature forest might be about 50 years old, and the trees 2 to 5 inches in diameter. In boggy areas, trees grow on sphagnum moss, sometimes underlain by peat that is over 25 feet deep. On better-drained sites, feathermosses are more typical and cover the ground in layers about 12 inches thick. There are also a few herbs and shrubs.

When the forest burns, there is very little left. The trees are dead, the moss is blackened, and the shrubs are killed. Gradually, the shrubs begin to regrow from the roots and rhizomes. Aspen regrow from root suckers, and birch from stem suckers. At the end of a year, some very small black spruce seedlings appear. The hotter the fire, the longer it takes for the green to come back. Within 5 years,

▲ Les Viereck takes weather measurements in the Wickersham burn; trees are black spruce.

trees may be 3 inches to 2 feet tall, the shrubs are coming back, and the willow trees are taller than a man's head. Blueberry shrubs have regrown and are producing berries again.

Eventually the burned spruce forest is replaced. Along the way, many species appear which provide good habitat for wildlife. For example, most of the large populations of moose in Alaska can be traced to a large fire or series of fires in the past that have increased the supply of shrubs, willows, and other hardwoods. Snowshoe rabbits also love the willow. They nibble the lower branches, leaving the upper branches to the moose.

Beneath the surface other things are going on. Much of the taiga is underlain by permafrost. Around Fairbanks, about 50 to 75 percent of the area is permafrost. The frozen soil extends from a foot or so beneath the surface down to 400 to 500 feet or more. Fire has a profound effect on the permafrost layer. The removal of the understory and the forest canopy allows sunlight to reach and warm the soil.

Ecologist Les Viereck of the Institute of Northern Forestry is an expert on both tundra and taiga vegetation, and has studied the effects of fire on the taiga environment. "Following fire," he says, "surface temperatures go up, warming the underlying permafrost, and causing melt. Thawing continues at a high level for 15 to 20 years. After about 25 to 30 years, the thawing rate recedes to where it was before the fire." Ecological information such as this is needed to develop policies for the management and protection of these northern forests from fire. It is important to know when and where fires should be controlled and where they should be left to go out naturally.

In developing a new program of fire research in the interior, researchers are also looking at the need for fire control studies. The environment is significantly different from other forest environments in the United States. Special techniques may be needed to manage the taiga.

It is very important to develop a fire management policy for the interior, one that will recognize the very special nature of the taiga ecosystem. If the natural mosaic of vegetation is to be maintained, then some fires must be allowed to burn. Otherwise, the tendency will be to move toward a climax spruce forest everywhere.

A fire management policy is also needed for maintaining caribou habitat. It is generally agreed that fire destroys the lichen-rich winter range of the caribou. Some have estimated that it may take as long as 100 years for the range to return to its pre-burn condition.

—By J. Louise Parker, Pacific Northwest Station

▲ The Pacific Northwest Station's Forestry Sciences Laboratory, Juneau, is supporting fish habitat research at Corner Bay.

Small streams and fish habitat

Phyllis Weber is an enthusiastic student of nature. A resident of Seattle, Washington, this perky 26-year-old University of Washington graduate student spent the summer of 1975 in Alaska studying the effect of logging on small streams. Her work is being done as partial requirement for a master's degree in forestry at the University of Washington. Field work will be completed in 1976.

The study area is at Corner Bay, southwest of Juneau, in the Tongass National Forest. Trees there are mature coastal Sitka spruce and hemlock, around 400 years old. Streams are small and typical of the watercourses that punctuate many mountainous regions in coastal Alaska. They have the added importance of being rearing areas for young Dolly Varden and coho salmon. Information gained from studying the environment of those small streams will help forest managers improve logging practices, especially as they relate to fish habitat.

Study plots are located in both undisturbed forest and in areas that have recently been clearcut. Data are being gathered on many environmental factors, including air and water temperature, aquatic insects, and plant communities.

From her work so far, Weber offers several observations about good logging practices. As far as fish habitat is concerned, the best logging practices ensure that:

- Debris is kept from streams—even the smallest tributaries. Nearly all provide some habitat for fish.
- Culverts are properly placed to enable passage of fish even during the lowest streamflow. Sometimes culverts are placed properly in the beginning, but end up being ineffective because of settling of the fill material.
- Clearcuts are designed to minimize the amount of stream that is exposed. Shrubs and other plants left along streambanks also help shade the stream and maintain proper water temperature.

When steep slopes must be logged, Weber believes the best system is skyline logging. She bases this observation on her previous Forest Service experience with PNW's logging engineering research unit, which is developing improved logging systems.

The research at Corner Bay is supported by the Forest Service through its Forestry Sciences Laboratory at Juneau. The Laboratory is one of two forestry research facilities maintained in Alaska by the Pacific Northwest Forest and Range Experiment Station.

Small streams important

In her field work, Weber works closely with Art Bloom, a fisheries biologist at the Juneau Lab. "The problem in Alaska is recognizing the importance of small streams as fish producers," Bloom says. "Most people understand the role that larger streams play in salmon spawning. But few know that the fish, especially coho salmon, use the very tiny feeder streams as rearing areas."

Research in the 1950's, on Prince of Wales Island, indicated that clearcutting did not adversely affect the salmon spawning habitat— at least with the research techniques used, no damage was detected. There was a moderate increase in stream temperature in the fall following logging. Streamflow and sedimentation also increased following logging, but no one knew what effect that may have had on fish habitat.

Researchers, including Bloom, now believe that very minor changes in environment do affect the fish, and that the early research methods were not accurate enough to detect the small changes in temperature or sediment that might have affected eggs or young fish.

Although the staff at Juneau is very small—there are positions for only two scientists and one technician—the group has undertaken a modest, but well-directed, research program on fish habitat. In addition to Art Bloom, the fisheries biologist who has been at the lab since 1973, the staff includes Bill Walkotten, a research technician.

Fish-rearing habitat

Bloom has some studies underway in the tributaries of the Kadashan River, a few miles west of Corner Bay. This is one of the best salmon-producing streams in southeast Alaska. He is studying fish-rearing habitat, looking at factors such as physical characteristics of streams, streamside vegetation, and food available for the fish. Bloom is now preparing reports on his work. The research results will help provide management prescriptions for protecting fish habitat during and after logging.

"Logging does not have to be detrimental to the fishery resource," Bloom says. "It's a matter of how it's done."

During some stages of development (particularly the "eyed" stage or until about 2 weeks after fertilization) the fish are especially vulnerable to environmental changes. Very small changes in stream temperature or sediment can cause mortality. Stream temperature is affected by the amount of vegetation along the streambanks. When an area is clearcut down to the edge of a stream, water temperature can go up as much as 10 to 20 degrees or more. This is important because an increase in temperature can affect spawning behavior, egg survival, and the survival and growth of fry. For one thing, fish eggs hatch according to the amount of heat they have accumulated. If the temperature is higher than normal, the eggs hatch sooner. They might even hatch before there are enough natural foods available for them.

Too much sediment in the streambed can also cause mortality. One of the research problems has been to develop devices that are sensitive enough to detect small changes in bedload sediment. Since salmon eggs are laid in gravel on stream bottoms, a suitable gravel sampling device is necessary.

▲ Phyllis Weber's study is of logging and small streams.

Unhappy with the devices available, Bloom's research technician Bill Walkotten invented an improved "gravel freeze sampler" using carbon dioxide to freeze a core of the streambed. The method is now being used by other researchers around the State.

The Walkotten sampler enables a biologist to remove a plug of frozen gravel from the streambed. To take a sample, a hollow copper probe is inserted in the streambed. The liquid carbon dioxide is then pumped into the probe. When the probe is pulled out again, a frozen section of streambed comes with it. This can then be studied in the laboratory (Research Note PNW-205-FR6). A device to measure waterflow in the gravels is also being developed.

Geography and weather conditions make it difficult to conduct research in Alaska. For example, all of the study areas are at considerable distances from the Lab's Juneau headquarters. Kadashan Bay is 50 air miles away, as is Corner Bay. Young Bay, another study area, is somewhat closer, but is often less accessible by boat or airplane. Maybeso Creek valley, where early watershed studies were conducted, is 240 miles.

The effective working season, in this rainy, cold part of southeast Alaska, is from the end of May to mid- or late September. Access is by helicopter, airplane, or boat. There are no roads or trails.

In such an environment, with a small staff, research results come slowly. But the work is important, and the lessons learned so far have been of help to foresters planning timber harvest programs in the Tongass National Forest. The fisheries work is conducted in cooperation with the Alaska Region of the Forest Service, and with the local fish and game agencies.

Catches decrease

Don Schmiege, who heads the research program in Juneau, says the coast of southeast Alaska is important for fisheries. There are literally thousands of salmon-producing streams that run through forested watersheds. Land management practices in coastal Alaska can have a significant effect on the fisheries resource.

"It's the freshwater habitat here we're interested in," Schmiege says. Other agencies, such as the Alaska Department of Fish and Game, the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service, have responsibility for keeping accurate fish counts and for research on saltwater habitat.

No one knows for sure just what effect logging has on salmon production. Salmon catches have fallen off dramatically since about 1945. Many people believe the real problem is overfishing—not just of salmon, but also fish the salmon eat, such as herring.

Habitat improvement research is also possible in the future. "There are many things that might be done to improve the fish habitat," Schmiege says. This might include removal of log jams, installation of fish ladders around natural barriers, and "riffle sifting" to rid the gravels of excess sediment.

Publications documenting this work include the following:

Meehan, William R. 1974. The Forest Ecosystem of Southeast Alaska. 3. Fish Habitats. USDA Forest Serv. Gen. Tech. Rep. PNW-15-FR6, 41 p.

Walkotten, William J. 1973. A Freezing Technique for Sampling Streambed Gravel. USDA Forest Serv. Res. Note PNW-205-FR6, 7 p.

—By J. Louise Parker, Pacific Northwest Station

Wilderness — a research challenge

Managers of wilderness areas face a tremendous challenge. Can they maintain a quality experience for the ever-increasing numbers of visitors? Fifteen times as many people are visiting wildernesses today as in the late 1940's. The burgeoning use threatens to turn pristine areas into "wilderness slums."

To meet this challenge, an Intermountain Forest and Range Experiment Station research unit was created in 1967 in Missoula, Montana. Missoula, located in the center of the northern Rocky Mountains, is an ideal place for wilderness research. This area contains the largest concentration of wilderness in the contiguous 48 states: there are 20 established Wilderness or Primitive Areas in National Forests, three major National Parks with wilderness lands, and a substantial area of still undeveloped roadless land in Montana, Idaho, Wyoming, and Utah. Two of the largest Wilderness Areas in the country, the Selway-Bitterroot and the Bob Marshall, are within 50 miles of Missoula.

Robert C. Lucas, leader of the wilderness research unit, says his team is "trying to lay a foundation of general studies of visitors and develop better research methods for more detailed studies later. This should provide the most relevant, helpful research in the long run and seems a better bet to us than crash programs dealing with individual 'brushfire' crises."

Lucas and George H. Stankey, also of the wilderness research unit, are concentrating on the ecological as well as the social problems of how to manage and protect established Wildernesses and Primitive Areas.

Ecological studies run the gamut from determining the impact of visitors and their horses on plants, soil, water, and wildlife to identifying the processes of ecological change that affect the whole wilderness.

Wildfire, and the results of its control, are major factors in the ecological changes in wilderness. A study conducted jointly by Forest Service land managers and Intermountain Station scientists in the White Cap Creek basin of the Selway-Bitterroot Wilderness in Idaho covered all aspects

▼ Horse travel and backpacking are traditional in wilderness.

of fire's role in wilderness and led to a new fire control policy that allows some fires, under carefully specified conditions, to burn naturally.

In a cooperative study with the University of Montana, forestry students supervised by Professor Sid Frissell investigated the vegetation history of the Danaher Creek basin in the Bob Marshall Wilderness. By determining the ages of fire scars on trees and of even-aged forests that followed many fires, a series of fire history maps was compiled. The history goes back over 200 years, and shows many large fires at lower elevations; at high elevations, fires were small.

Stankey is studying what visitors know about fire in wilderness and how they feel about it. He is finding that the more visitors know about fire, the more they tend to favor management programs that allow fire to play a more natural ecological role.

The Intermountain Station has supported three studies of "wear and tear" on campsites and trails. In the Spanish Peaks Primitive Area of Montana, Professor Frissell classified over 50 campsites according to their stage of deterioration. A "condition class" rating scheme was then developed, with suggested management actions for each class.

In a related study, Professor Perry Brown and John Schomaker of Colorado State University are developing a method to identify and inventory potential campsites that could increase the carrying capacity of the area, if visitors knew of them. During three trips to Spanish Peaks, they evaluated 88 existing campsites, documenting critical requirements such as levelness and size of area, distance to water, visibility of water, firewood supply, and soil moisture conditions. Using these criteria, the team developed a system to locate spots on aerial photographs that meet these requirements. Fifty-two percent of the sites identified from the photos proved to be suitable for camping.

▼ Surveys show visitors give scenic beauty priority.

Carrying capacity

A cooperative study with Washington State University dealt with the relationship of environmental factors to trail deterioration. In 1972, Sheila Helgath, working on her master's thesis, spent 6 months tramping the trails of the Selway-Bitterroot Wilderness in Idaho, recording such factors as trail steepness and erosion. Her findings indicate that use is not the main cause of deterioration. Instead, the choice of location for the trail, its construction, and its maintenance are critical. Helgath identified situations where trail construction would be risky.

Social management of the wilderness poses many diverse problems. Lucas says, "We do not know nearly enough about how people use the wilderness, what they are seeking, or how different policies would affect their behavior and satisfaction. One of the key phrases in the Wilderness Act of 1974 is 'outstanding opportunities for solitude or a primitive or unconfined type of recreation,' but what 'outstanding solitude' really means is debatable. We hope that our research will provide some of the answers."

One of the most pressing questions concerns recreational carrying capacity, or just how much use wilderness can support and still provide the visitor with a satisfactory wilderness experience. Any use brings biological change. So, the research team wants to know what visitors define as "too much change" and what they think constitutes the wrong kind of use.

During the 1969 summer season, Stankey interviewed nearly 500 visitors to four areas—the Bob Marshall Wilderness in Montana, the Bridger Wilderness in Wyoming, the High Uintas Primitive Area in Utah, and the Boundary Waters Canoe Area in Minnesota. He asked how they felt about four aspects of wilderness carrying capacity: (1) the level of use; (2) the types of use; (3) the loca-

tion of encounters with others and the timing of those encounters; and (4) the effects of inappropriate behavior, specifically littering and campsite wear and tear. An attitude scale was used to determine how closely each person's concept of wilderness agreed with the philosophies of the Wilderness Act.

Most of the visitors said solitude was one of their main reasons for visiting wilderness, and they enjoyed experiencing it. More than one-third of those surveyed felt that wilderness areas are being used beyond their capacity.

Lucas tested methods for accurately estimating wilderness use. In the Mission Mountains Primitive Area in Montana, he found that trail register data were incomplete because only about 65 percent of the visitors registered. In a later study, Lucas found only a 28 percent registration rate for a portion of the Selway-Bitterroot Wilderness in Montana. He feels that a permit system for the wilderness of the northern Rockies could strengthen management's ability to protect wilderness as well as to make research more effective.

Wilderness in a computer

Intermountain Station scientists and cooperators from Resources for the Future have developed an exciting new tool for planning how to manage wilderness use. Their simulation model of wilderness visitor flows is a sort of "wilderness in a computer." The manager will be able to test alternative policies for modifying visitor use before plans are adopted. He can run proposed plans through the computer and—in minutes—have a good idea of what the resulting visitor travel pattern and solitude levels would be.

Visitor information seems to be a potentially powerful management tool that avoids visitor regimentation. In 1974, Lucas and Stankey cooperated with personnel of the Bitterroot National Forest, Montana, to develop a special brochure, "Routes to the Wilderness." The brochure informs visitors which trails on one portion of the Selway-Bitterroot Wilderness are most traveled. The pamphlet guides them to locating the ones which, in the past, have remained relatively unexplored, and also suggests some ways the Wilderness can be used carefully, with minimum impact. Copies of the brochure were placed at 10 trailheads to see if use patterns could be shifted. A study will monitor the brochure's effectiveness.

As Lucas and Stankey analyze their information, they are developing recommendations that they hope will improve wilderness planning and management. Lucas says, "The efforts and cooperation of researchers, managers, and users will be required to protect our wilderness heritage and use it carefully."

Publications available

If you would like to know more about these studies, write to the Intermountain Forest and Range Experiment Station for the following publications:

Helgath, Sheila F. 1975. Trail Deterioration in the Selway-Bitterroot Wilderness. USDA Forest Serv. Res. Note INT-193-FR6. 15 p.

Lucas, Robert C. 1971. The Challenge and the Response to Forest Service Wilderness Management in the Rockies. *Naturalist* 22(3):2-5.

Lucas, Robert C. 1973. Wilderness: A Management Framework. *J. Soil and Water Conserv.* 28(4):150-154.

Lucas, Robert C. 1974. Forest Service Wilderness Research in the Rockies, What We've Learned So Far. *Western Wildlands* 1(2):5-12.

Lucas, Robert C. 1975. Low Trail Register Compliance Rates. USDA Forest Serv. Res. Note INT-200-FR6. 6 p.

Lucas, Robert C., and Jerry L. Oltman. 1971. Survey Sampling Wilderness Visitors. *J. Leis. Res.* 3(1):28-43.

Lucas, Robert C., Hans T. Schreuder, and George A. James. 1971. Wilderness Use Estimation: A Pilot Test of Sampling Procedures on the Mission Mountains Primitive Area. USDA Forest Serv. Res. Pap. INT-109-FR6. 44 p.

Stankey, George H. 1971. Myths in Wilderness Decision-Making. *J. Soil and Water Conserv.* 26(5):183-188.

Stankey, George H. 1973. Visitor Perception of Wilderness Recreation Carrying Capacity. USDA Forest Serv. Res. Pap. INT-142-FR6. 61 p.

Stankey, George H., and David W. Lime, compilers. 1973. Recreational Carrying Capacity: An Annotated Bibliography. USDA Forest Serv. Gen. Tech. Rep. INT-3-FR6. 45 p.

—By Delpha Noble, Intermountain Station

Publications

▲ Auke Lake, 12 miles northwest of Juneau.

Alaska series

Researchers at the Pacific Northwest Station have authored a series of nine reports about the forest ecosystem of southeast Alaska. Each report summarizes information about a specific component of the ecosystem.

Reports currently available include, "The Setting," "Forest Insects," "Fish Habitats," "Wildlife Habitats," "Soil Mass Movement," "Forest Diseases," "Forest Ecology and Timber Management," "Water and Timber Inventory," and "Harvesting, Marketing, and Trends." Plans are for Volume 10 to be about "Forest Recreation."

The reports are available individually, or in a packet of all nine titles, from the Pacific Northwest Station, Portland.

Wildland glossary

The forester, the geographer, and the regional planner each bring to land-use planning the expertise that is needed to get the job done. However, these specialists, and others from range management, hydrology, and related fields, also bring to the meeting-room table their specialized vocabularies—professional terms that their planning teammates may not be familiar with. It's not surprising that difficulties in comprehension bog down the planning process.

To help solve this problem, three researchers at the Pacific Southwest Station, Charles F. Schwarz, Edward C. Thor, and Gary H. Elsner, have compiled and defined terms commonly used in land-use planning. Their "Wildland Planning Glossary" (General Technical Report PSW-13-FR6) has definitions for 1,400 terms, ranging from "abiotic" to "zooplankton."

The entries are from at least 15 different disciplines—economics, design, landscape architecture, mining, law, and sociology, in addition to the earth and biological sciences. For definitions, the authors consulted over 200 references, which they list at the end of the Glossary. This bibliography includes fairly well-known publications such as the "Terminology of Forest Science, Technology, Practice, and Products," published by the Society of American Foresters, to lesser-known references—a 97-page "Vocabulary of Land Planning," published in London, and a 59-page "Digital Mapping Glossary."

The Glossary has excerpts from the text of about 16 national laws that affect land-use planning, such as the Endangered Species Act of 1973. Entries range in length from capsule definitions taken directly from Webster's to entries with four or five definitions, each from a different source. The authors give synonyms for many of the terms, and state the source of each definition. They also give an alphabetical listing of the entries, and suggest that this list might serve as a thesaurus

"for the writer who is groping for the right term." They think their Glossary is the first of its kind to be published in the U.S. They hope it won't be the last: readers are invited to send in additions and clarifications, all of which could go into a revised edition of this reference book.

Nursery diseases guide

Forest nurseries supply quality seedlings to help replenish forest deficits. Planting is essential to reestablish forests in areas where natural regeneration is difficult. Nurseries also provide hardy seedlings to start new plantations in places such as the Great Plains, where native tree cover is sparse. But, seedling diseases frustrate the efforts of nurserymen to meet these demands for planting stock.

A handbook is now available with information about major forest nursery diseases. Nurserymen, foresters, extension pathologists, and others will find this book helpful in identifying, evaluating, and controlling these diseases. Pathologists Glenn W. Peterson of the Rocky Mountain Forest and Range Experiment Station, Lincoln, Nebraska; and Richard S. Smith, Jr., of the Pacific Southwest Forest and Range Experiment Station, Berkeley, California, are the technical coordinators for the book, entitled "Forest Nursery Diseases in the United States," Agriculture Handbook No. 470.

In compiling this book, Peterson and Smith called on 16 additional authorities to contribute writeups on the diseases that are most likely to cause serious losses in forest nurseries.

The authors discuss 31 root, stem, branch, and foliage diseases, describing the distribution, life history, hosts, damage, and control of each. Reference lists are included with the articles. The Handbook also has short discussions on storage molds and on the effects of air pollution. For copies, write the Rocky Mountain Station, Fort Collins.

Wildlife bibliography

Looking for literature to help you solve wildlife problems? If you work in the Southwest, a new bibliography published by the Rocky Mountain Forest and Range Experiment Station may help.

David R. Patton, research wildlife biologist at the Station's Tempe, Arizona, laboratory, and Peter F. Ffolliott, associate professor at the University of Arizona, compiled the bibliography. It is, "Selected Bibliography of Wildlife and Habitats for the Southwest," General Technical Report RM-16-FR6.

The publication contains 390 references to the types of literature most often requested by wildlife biologists in the Southwest. Because of the great amount of material available, the authors had to exclude periodicals devoted to a single animal species; information on small rodents, amphibians, reptiles, and bats; and inaccessible articles.

The references cover the period 1913 to 1975. They are listed by author; a subject index is also provided. Copies may be ordered from the Rocky Mountain Station.

Determining allowable cut

When improved cultural techniques such as thinning or fertilization are used, how will these growth-stimulating treatments affect allowable cuts? This question was recently tackled by two forest economists with the Pacific Northwest Forest and Range Experiment Station in Portland, Oregon.

Roger D. Fight and Dennis L. Schweitzer discuss the "Sensitivity of Allowable Cuts to Intensive Management" in General Technical Report PNW-26-FR6. The authors make no judgment about the desirability of even flow. But they have a lot to say about how allowable cuts will be affected by response to growth-stimulating treatments, changes in the acreage base, and changes in the extent or the age-class distribution of timber inventories.

Fight and Schweitzer selected the 100,000-acre Columbia and Alsea-Rickreall Master Units of the Bureau of Land Management in western Oregon for their study. While these forests are quite similar in their productive potential, they differ markedly in age-class distribution and standing volume of timber.

Their analyses show that allowable cut responds more to changes in long-term growth when: (1) the initial inventory is higher; (2) the age classes are more evenly distributed; (3) the growth increases can be cut sooner; and (4) the growth increases are smaller in proportion to the allowable cut.

Allowable cuts respond more to changes in inventory or short-term growth where: (1) the initial inventory is lower; and (2) the inventory is less evenly distributed.

Montana timber production

Most foresters agree that greater timber production is possible through intensified timber management. A report by Theodore S. Setzer, Intermountain Station resource analyst, supports this opinion.

In "Comparing Actual Timber Growth with Potential: Some Implications for Montana" (Research Note INT-188-FR6) Setzer cites growth data representing 2.8 million acres of Montana's 16 million acres of commercial forest land. In 1970, these acres produced about 190 million cubic feet of wood.

Setzer says, "If prompt regeneration and adequate thinning methods could be used to the theoretical maximum, these 2.8 million acres could produce 270 million cubic feet of wood, an increase of 42 percent."

In his report, Setzer also discusses the potential for the entire 16 million acres of Montana forest land that were classified as commercial for timber production in 1970.

Setzer says that although his analysis is limited to wood production, it could serve as a benchmark for monitoring management progress. He adds that other considerations are also important. These include the cost and rate of return of achieving potential production; the effects of not managing low-productivity forest land supporting insect-infested or diseased trees; and the necessity of accommodating nontimber uses on some commercial timberland.

Controlling erosion

The ponderosa pine is a "natural" for the part it can play in controlling soil erosion on the steep road fills of the Idaho Batholith. A Forest Service study conducted on the Boise National Forest showed that plantings of ponderosa seedlings with straw mulch applications and netting reduced erosion an average of about 95 percent over a 3-year period. Seedlings alone reduced erosion about 40 percent.

Walter F. Megahan, leader of the Intermountain Forest and Range Experiment Station's Forestry Sciences Laboratory in Boise, began the study in 1968 to see how the native ponderosa would control erosion on exposed Batholith soils. The shallow, coarse-textured soils over granitic rock of the Batholith are highly susceptible to both natural and man-caused erosion.

Previous studies showed that grass seeding reduced surface erosion on road fills in the Zena Creek area of the Payette National Forest. However, in some cases, when the soils became saturated with water, the grasses did not provide the stability needed to prevent the surface soil from flowing down the hillside like wet concrete.

For the 1968 study, the researchers found an ideal study site on a road fill 200 feet long on the Deadwood River Road, Boise National Forest. The fill had been constructed in 1957; early revegetation attempts had failed. In the study, researchers used applications of grass seed, ponderosa pine seed, straw mulch, erosion net, fertilizer, and ponderosa

pine seedlings—singly and in combinations. All growth, survival, and erosion data were collected from 1969 to 1973.

The planted trees were a hit. They were much more effective than seeded trees or seeded grass. Six of 18 study plots showed 100 percent survival of planted trees after 4 years. Only 2 plots had less than 95 percent survival. The planted trees also had better growth and vigor than the seeded trees and grass. The researchers concluded that, if possible, trees should be fertilized to accelerate growth, especially root growth. As a result of the study, they recommend planting ponderosa at a 3- by 3- or 4- by 4-foot spacing.

The ponderosa is plentiful, well adapted to mineral soils, grows fast, and has an extensive root system with a strong taproot. And it is right in the Batholith's "own backyard"—the Forest Service's Lucky Peak Nursery at Boise produces millions of ponderosa seedlings each year.

Write to the Intermountain Forest and Range Experiment Station for a copy of "Deep-Rooted Plants for Erosion Control on Granitic Road Fills in the Idaho Batholith," Research Paper INT-161-FR6, by Walter F. Megahan.

Prediction system

A numbers system is better than a green thumb when it comes to predicting if seedings or shrub plantings for game forage will be successful in areas of central Utah.

That premise led Forest Service and cooperating scientists to develop an objective system that can be easily used by land managers who need to know what to expect when planning revegetation programs.

Richard Stevens and Bruce C. Giunta of the Utah Division of Wildlife Resources, and A. Perry Plummer and Chester E. Jensen of the Intermountain Forest and Range Experiment Station, conducted a 5-year study of vegetation growth on 21 sites in central Utah. They developed charts showing productivity potential derived from mathematical models of the forage produced and measured from the study plots.

The new prediction system adds precipitation, percent rock, slope steepness, and other information to basic soil survey data. Chances of revegetation success in the principal foothill range areas are rated in five categories from low to high.

The system is described in "Site Productivity Classification for Selected Species on Winter Big Game Range in Utah," Research Paper INT-158-FR6.

You have now received six issues of *Forestry Research: What's New in the West,* either at the mailing address indicated on the back cover label, or as part of a bulk mailing. If you have friends who would be interested in this publication, you may wish to let them know they can be added to the mailing list by filling out the coupon below and mailing it to us.

Please add my name to the mailing list for *Forestry Research: What's New in the West:*

____

____

ZIP ____________

Mail to: *Forestry Research: What's New in the West*
U.S. Dep. of Agriculture
Forest Service
240 West Prospect Street
Fort Collins, Colorado 80521

FORESTRY RESEARCH: What's New in the West
U.S. Department of Agriculture Forest Service
240 West Prospect Street
Fort Collins, Colorado 80521

Official Business
Penalty for Private Use, $300

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF AGRICULTURE
AGR – 101

SO 03/12/76
NTNL AGRICULTURAL LIBRARY
CURRENT SERIES RECORDS
BELTSVILLE MD 20705